

1           1.    A MIMO-based space-time wireless sensor node and  
2 transceiver comprising:  
3           a sensor array unit;  
4           an A/D converter unit;  
5           a signal processing and data computing unit;  
6           a MIMO-based space-time transceiver;  
7           a memory bank;  
8           a power unit;  
9           a power generator; and  
10          a multiple antenna unit.

11          2.    The MIMO-based space-time wireless sensor node  
12 and transceiver of claim 1 wherein the sensor array unit  
13 includes N sensors, which each of the sensors is a  
14 multimode sensor device.

15          3.    The MIMO-based space-time wireless sensor node  
16 and transceiver of claim 2 wherein said multimode sensor  
17 device that can be one of electronic, optical, chemical,  
18 nuclear fusion, gas/liquid, or any combination sensing is  
19 use to sensor different input signals.

20          4.    The MIMO-based space-time wireless sensor node  
21 and transceiver of claim 1 wherein the MIMO-based space-  
22 time transceiver comprises a sensor data sequence stream, a  
23 FEC, interleaver and spreading, a space-time encoding, a

24 modulation and radio frequency transceiver, and a multiple  
25 antenna array.

26         5. The MIMO-based space-time wireless sensor node  
27 and transceiver of claim 4 wherein said FEC, interleaver  
28 and spreading further includes a convolution encoder, an  
29 interleaver, a pseudorandom spreader, a sensor node mask  
30 code, and a pseudorandom sequence generator.

31         6. The MIMO-based space-time wireless sensor node  
32 and transceiver of claim 4 wherein said space-time encoding  
33 further includes a counterclockwise multirate switch unit,  
34  $K$  sensor channel memory banks,  $K$  spreaders, an orthogonal  
35 sequence generator, a dual-mode switch unit, a block sum,  
36 and a serial-to-parallel (S/P).

37         7. The MIMO-based space-time wireless sensor node  
38 and transceiver of claim 6 wherein said counterclockwise  
39 multirate switch unit is an interleaver down-sampling  
40 operation to produce  $K$  parallel sequences of a length of  
41  $L/K$  with a chip rate of  $M$  Mcps from a single input sequence  
42 of a length of  $L$  with a chip rate of  $KM$  Mcps.

43         8. The MIMO-based space-time wireless sensor node  
44 and transceiver of claim 6 wherein said dual-mode switch

45 unit is used to form either MIMO or SIMO followed by the  
46 block sum and the S/P.

47 9. The MIMO-based space-time wireless sensor node  
48 and transceiver of claim 6 wherein said orthogonal sequence  
49 generator produces all of the sequences with orthogonal  
50 each other.

51 10. The MIMO-based space-time wireless sensor node  
52 and transceiver of claim 6 wherein each of  $K$  spreaders is  
53 an exclusive-OR (XOR) operation.

54 11. A MIMO-based space-time sensor basestation  
55 comprising:  
56 a multiple antenna unit;  
57 a demodulation and radio frequency receiver;  
58 a space-time processor and decoding;  
59 a space-time Rake processor;  
60 a deinterleaver and FEC decoding;  
61 a MIMO channel estimate; and  
62 a pseudorandom sequence generator.

63 12. The MIMO-based space-time sensor basestation of  
64 claim 11 wherein the MIMO channel estimate is either using  
65 a training sequence or using a blind estimate method for  
66 channel identification.

67           13. The MIMO-based space-time sensor basestation of  
68 claim 11 wherein said space-time processor and decoding  
69 further includes a space-time matrix equalizer,  $K$   
70 despreaders,  $K$  receiver channel memory banks, a clockwise  
71 multirate switch unit, and an orthogonal sequence  
72 generator.

73           14. The MIMO-based space-time sensor basestation of  
74 claim 13 wherein said space-time matrix equalizer is a  
75 space-time MMSE equalizer.

76           15. The MIMO-based space-time sensor basestation of  
77 claim 13 wherein said clockwise multirate switch unit is a  
78 deinterleaver up-sampling operation to form a single  
79 sequence of a length of  $L$  with  $KM$  Mcps from  $K$  parallel  
80 sequences of a length of  $L/K$  with  $M$  Mcps.

81           16. A system of MIMO-based space-time wireless sensor  
82 node comprises a power unit coupled to a power generator, /  
83 and a power saving mode of operation.

84           17. The system of MIMO-based space-time wireless  
85 sensor node of claim 16 wherein the power generator is one  
86 of type powers including solar cells, low-power DC source,  
87 or any combinations.

88           18. The system of MIMO-based space-time wireless  
89 sensor node of claim 16 wherein the power saving mode of  
90 operation further includes a full operation mode, a sleep  
91 mode, a wake-up mode, and a partial operation mode.

92           19. The system of MIMO-based space-time wireless  
93 sensor node of claim 18 wherein said sleep mode indicates  
94 that the MIMO-based space-time sensor node is in idle.

95           20. The system of MIMO-based space-time wireless  
96 sensor node of claim 18 wherein said wake-up mode is used  
97 to randomly wake up the MIMO-based space-time sensor node  
98 during setup and to turn the MIMO-based space-time sensor  
99 node transceiver off while in inactive.

100          21. The system of MIMO-based space-time wireless  
101 sensor node of claim 18 wherein said partial operation mode  
102 is used to operate a sensor array unit, an A/D converter  
103 unit, and a signal processing and data computing unit, and  
104 can be switched into the full operation mode or the sleep  
105 mode.